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DEVELOPMENT OF SECONDARY SCHOOL AGRICULTURE IN CALIFORNIA

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AND
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WHAT OUGHT TO BE FOUND IN A WELL-ORGANIZED AGRICULTURAL COURSE.*

There are certain things of a general nature which ought to be found in classes in agriculture as well as in other lines of high school work. The more important of these are as follows:

I. A *teacher* who is master of the fundamental principles of agriculture and in complete sympathy with the work.

II. Pupils interested, attentive and alert; quick in response and ready with questions.

III. Material evidences of well planned, everyday work such as:

1. Note-books.
2. Collections of materials.
3. Special apparatus.
4. Charts, maps, pictures.
5. Blackboard outlines.
6. Reference books that give evidence of being used.

WHAT OUGHT NOT TO BE FOUND IN AN AGRICULTURAL COURSE.*

There are at least four things which should not be found in a well-organized agricultural course. They may be concisely stated as follows:

I. Agriculture taught by a city woman, ignorant of farm conditions and farm life.

II. Formal and perfunctory work, of the "question and answer" text-book style.

III. The course taken only by students who have partially or completely failed in all of their other work.

IV. The course overloaded with "specialized" forms of agriculture to the exclusion of other important high school work.

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* Quoted from Bulletin of the University of Wisconsin No. 441, High School Series, No. 12, "The High School Course in Agriculture," by K. L. Hatch, Associate Professor of Agricultural Education.

DEVELOPMENT OF SECONDARY SCHOOL AGRICULTURE IN CALIFORNIA

By E. B. BABCOCK.

The whole development of agricultural education in its primary and secondary school phases in California is recent. Eight years ago the College of Agriculture of the University of California was the only institution in the state giving regular instruction in agriculture. To-day agricultural education exists to some extent, at least, in six different classes of schools besides the State University. These are the normal schools, special state schools (at San Luis Obispo and Davis), the public high schools, the public elementary schools, the state industrial schools and private schools and colleges.

In December, 1905, Dr. A. C. True, Director of the Office of Experiment Stations of the United States Department of Agriculture, spoke in Berkeley on "Why the Friends of Agricultural Progress Believe that Agriculture Should and Will be Taught in the Public Schools." His sound arguments and the vital relation which he indicated between true culture and the vocational studies did much to encourage the introduction of such studies in this state. This address was published by the College of Agriculture as Circular 17 and is still available.

The legislature of 1901 had passed the act for the California Polytechnic School at San Luis Obispo and two years later the school came into being, with Dr. Leroy Anderson in charge. This was the first institution outside the University of California to offer instruction in agriculture. Of the total number enrolled (176) somewhat over one-third are in the agricultural course.

The legislature of 1905 made the first appropriation for the University Farm and the University Farm School at Davis. This was a most important step for two reasons. (1) The institution offers opportunity for stock, dairy, field, and horticultural practice for college students at Berkeley. They are allowed to spend one half-

year during their undergraduate course at Davis. (2) It provides an especially equipped school of agriculture for boys who have finished the eighth grade, who want to be successful farmers. A three-year practical course which does not prepare for the University is now offered.

The first building at the Farm, the dairy building, was completed in 1908. That year Dr. Anderson came to Berkeley as Professor of Agricultural Practice and Superintendent of University Farm Schools and then began his active efforts on behalf of secondary instruction in agriculture in this state. His experience at San Luis Obispo and investigations in the East fitted him especially for this work. He has built up an excellent school at Davis. At the same time he has done much to encourage the introduction of agricultural subjects into California high schools.

At Dr. Anderson's request, in 1909, the University of California added dairying and horticulture to the list of elective matriculation subjects. This act had an immediate effect of encouragement among high school people, some of whom were already considering the addition of such studies to their curriculum. A year later there was added another subject, general agriculture, to this list. Whether these subjects are made use of or not by the progressive high schools of the future, they have served a good purpose already, as stated, and will continue to encourage the smaller high schools.

Simultaneously with the provision for matriculation credit in agricultural subjects, Dr. Anderson and the writer arranged to give the first courses designed especially to prepare teachers of agriculture. These have been expanded until now the College of Agriculture offers seven such courses and employs three instructors especially for this work.

Self-directed high school development is surely much in evidence as far as agriculture is concerned. Indeed we find agriculture being handled in nearly as many ways as there are high schools including it in their course of study. But we can distinguish three types or stages of development.

(1) The One Course Type—usually small schools. The sciences, those that they have, are taught without much effort to apply them to agricultural or other industries. But one course, sometimes required in the ninth grade, sometimes elective, is offered; usually this is general agriculture, because there are now good texts. This is good as far as it goes and in some schools home projects and other extra program work add much to the value of the course. The Analy

Union High School at Sebastopol offers a good illustration of such a course.

(2) The Applied Science Type. Physical geography, general science, botany, etc., are taught with the direct aim to impart as many of the fundamental principles of agriculture as possible. The Oxnard High School is a good example of this type, although it will add special courses next year.[1]

(3) The Full Course Type. A complete four-year course including one agricultural study or applied science each half-year. Such courses are now offered or soon will be in the Stockton, Fresno and Gardena High Schools.

The first public high school to make a beginning in agricultural instruction was the Gardena High School of Los Angeles City. In 1908 Mr. F. H. Bolster was employed at this school to give instruction in general science and botany with special reference to agriculture.[2] In 1909, the schools at Imperial, Oxnard and Bakersfield employed technically trained men to present agricultural subjects in those schools.

During 1909 several other high schools were making experiments in a small way. Among these may be noted the schools at Vacaville, Glendale, Hanford, Tulare, Ventura, Santa Cruz and others. During 1910 the following schools placed technically trained men in charge of agricultural courses in their high schools: Stockton, Fresno, Escondido, Hollywood, Lordsburg, Livermore, and Ferndale. The following schools began single courses in general agriculture under the direction of a science teacher: Sebastopol, Porterville, Hanford, Salinas and Le Grand.

Following is a brief chronological outline which summarizes the development of high school agriculture in California.

SUMMARY OF DEVELOPMENT OF HIGH SCHOOL AGRICULTURE IN CALIFORNIA.

1908. Gardena—Botany and general science with special reference to agriculture.

1909. Gardena—14-acre farm purchased for $14,000; an irrigation system installed; lath house, mushroom house and greenhouse constructed; glassware and apparatus provided for laboratory work.

Imperial—School garden established; botany and dairy laboratories equipped.

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[1] See Report, p. 29.

[2] "Agriculture in the High Schools," by Leroy Anderson, Circular 47, Agricultural Experiment Station, Berkeley, p. 5.

Oxnard—School garden established; greenhouse built; laboratory equipped.

Bakersfield—Laboratories equipped.

Tulare and Hanford—General courses with laboratory.

1910. Gardena—School organized as Gardena Agricultural High School; enrolment 93. Thirty-three per cent of pupils enrolled were taking agriculture in November, 1910.

Imperial—Enrolment 80; 5 per cent of pupils were enrolled in agriculture in November, 1910.

Oxnard—Enrolment 80. Percentage in agriculture 33—November, 1910. See list of equipment in Appendix A.

Bakersfield—27 acres of land purchased for $16,000, besides cost of clearing, grading and planting to alfalfa and cereals. (Dairy herd and dairy to be installed). Enrolment 307. Seven per cent in agriculture in November, 1910.

Fresno—A single course introduced in February. In September courses in general agriculture and dairying introduced. Seven per cent of pupils enrolled are in agriculture—November, 1910.

Stockton—Courses in general agriculture, poultry and dairying. Enrolment 530. Nine per cent taking agriculture in November, 1910.

Livermore—Courses in general agriculture, horticulture and dairying introduced. Enrolment 110. Twenty-one per cent of pupils enrolled were taking agriculture in November, 1910.

Ferndale—Courses in general agriculture and dairying introduced.

Lordsburg—10 acres divided into orchard and field crop plots; potting house, lath house, greenhouse; laboratory equipment, including gasolene gas plant.

Hollywood—Course in horticulture introduced. Enrolment 450. Two and two-thirds per cent in horticulture in November, 1910.

Escondido—Courses in general agriculture and horticulture introduced. Several acres of land on site.

The following schools have introduced a course in general agriculture: Sebastopol, Salinas, Le Grand, Porterville, Brawley, Ceres, Los Angeles Polytechnic, Petaluma.

The following schools have attempted to correlate science studies with agriculture: Santa Cruz, Ventura, Colusa, Huntington Beach, Hanford, Santa Maria.

The following schools have signified intention to introduce agriculture in the near future: Claremont, San Bernardino, Riverside, Azusa, Monrovia, Huntington Park (which now has 16 acres of land), Selma, King City, Monterey, Visalia, Auburn, Ventura, Centerville, Ontario, and doubtless others.

REPORT ON AGRICULTURE IN CALIFORNIA HIGH SCHOOLS.

By C. J. BOOTH.

There are in the state at the present time at least a score of public high schools offering instruction in some phase of agriculture. At the following schools men are now employed for the purpose primarily of teaching the agricultural subjects: Hollywood, Gardena, Fresno, Kern County at Bakersfield, Oxnard, Livermore, Stockton, Brawley, Imperial (Lordsburg, Escondido, and Ferndale). In addition to these, agriculture receives attention in the curricula of several other schools: Huntington Beach, Hanford, Santa Maria (Salinas, Sebastopol, Le Grand, Porterville, Ventura, Santa Cruz, Colusa, Hanford, Tulare and no doubt others).

The opportunity came to me last fall to visit all the above named schools, except those enclosed in parentheses, for the special purpose of seeing at first hand the results of the incorporation of agriculture into the public secondary schools of the state. What I shall have to say about the development of the subject in California will be based, therefore, on what I saw at that time.

I attempted, in visiting the different schools, to examine as far as possible all the main factors that entered into each case. Data were collected regarding the reasons for the establishment of the special courses, with an effort in each case to come as closely as possible to the ultimate motive. I made it a point to ascertain at each school the cost of the course in salary and equipment, as well as the number of students enrolled. It was found to be of interest and profit, also, to inquire into the relation of the agricultural courses to the other science courses—and instructors— of the several schools. The methods of the teacher, as regarded use of garden, experimental plot, etc., were always interesting; and the attitude of the community, while not always easy to determine in so short a time, was of course a real factor in each case. Then, each instructor had his own method of teaching. The fact that classes bear the same name in different schools is no guarantee that

they have a very strong resemblance; a fact not surprising when it is remembered that in the main they are being given for the first time this year. Finally, and to my mind by far most important of all, I tried to gain some idea of the teacher himself; his ability, his preparation; above all, his personality as it impressed itself upon the students in the class room and elsewhere.

Agriculture in the secondary schools of California presents as many aspects as there are different schools dealing with the subject. The state schools at San Luis Obispo and Davis are in a class by themselves. They are doing their own work in their own way. Their support comes directly from the Legislature, and they bear no such relation to the communities in which they are situated as do the local schools.

There is also a wide divergence among the high schools. Such a school as that at Bakersfield has a county to draw on for support, and an agricultural community to serve; while other schools have comparatively scant revenues, and patrons who may or may not be in sympathy with such apparent innovations as agriculture.

The Santa Maria High School advertises in its course of study that about one-fourth of the time in the science classes is devoted to agricultural aspects of the several subjects; and since there are four science courses, the aggregate amount of agricultural instruction is therefore equivalent to a year course. This arrangement is typical of that worked out in several of the schools.

There is always a tendency in these cases for either the agriculture or the regular science to predominate. In the case of the Santa Maria school the latter is the case. The science teacher has studied some phases of agriculture, such as chemistry of soils, and has given a year course in the subject. At the same time, his class work can hardly be referred to as agricultural in the same sense that a course in agricultural chemistry at the University Farm School would be so designated. In a similar way, the botany instructor uses Osterhout's "Experiments with Plants" as a text, and gives not a little experimental work that is directly allied with agricultural practice. But the botany again, rather than the agriculture, predominates. On the other hand, the course at Oxnard illustrates the opposite tendency. The natural science teacher has two classes, one of which he calls general science, the other, botany. But the greater part of the work in each case is agricultural.[3]

In other schools, either on account of public demand or for other

[3] See report on Oxnard school, pp. 39, 40.

causes, the subject has been introduced in a more systematic manner. At Stockton the instructor has three classes in agriculture—general agriculture, livestock, and dairying. There is a total enrolment of 530; nine per cent of this number are taking one or more agricultural courses.

The subject has been well advertised, City Superintendent of Schools James A. Barr having outlined his plans in some detail. They may be summarized as follows. There are to be two high school courses, one of two years, the other of four years. The course for boys is to be planned with reference to the problems of the region about Stockton, and that for girls to be along the line of domestic arts. The director in charge of the course is to confer constantly with farmers relative to their problems, and to direct, in coöperation with the University, short courses for their benefit. The Director is to issue leaflets bearing on the agricultural problems of the district, to hold teachers' institutes in the interest of agricultural teaching, and to have charge of the work in nature study, elementary agriculture and school gardening. In addition to these lines of endeavor, the high school department is to carry on experimentation in different parts of the county, partly on its own initiative, partly in coöperation with the Experiment Station at Berkeley and with the United States Department of Agriculture.

There is undoubted good in putting the work of any school before the community. At the same time, this school is teaching the people to expect a great deal. Work that is too hasty in the beginning may be delayed on that account at a later stage in its development.

At the Hollywood High School there is an attendance of 450 students. A group of buildings just completed and adequately equipped with apparatus places it among the foremost schools in this respect. The principal is a firm believer in the need of agricultural instruction, and is planning accordingly. Three rooms in the new science building will be devoted to agriculture; one provided with lockers for tools, one for supplies, one in which to do indoor laboratory work. In addition to these there is a propagating house, 12 x 50 feet, covered with glass, with shelves within, and it is intended that a portion of the school grounds will be used for garden purposes. There is not the demand here for agriculture that exists in more distinctly agricultural communities; nor are the channels of administrative operation such that the development of the subject will be favored to any great extent, for Hollywood like the other schools of Los Angeles is under the direct supervision of the City Board of Education.

In this connection, the case of Gardena is an interesting one. It likewise is under the supervision of the same board, but it is generally understood that this school will in its development be a distinctly agricultural institution. There are this year three agricultural courses: general science, which is required of all freshmen; horticulture and botany. The instructor in agriculture is well qualified for his work.

If I were to select the one school in California which I think illustrates beyond others a rational development of all the problems—class-room work, experiment station and the rest—of agricultural instruction, I should choose the Kern County High School. It is located at Bakersfield and has an attendance of 307. It draws its students from all parts of the county. It has a course of study adapted to the peculiar conditions of that locality, as shown by the following arrangement. During the first two years there is practically one course only, but at the beginning of the junior year the student may choose one of the following courses: Academic, Domestic, Commercial, Wood-working, Metal-working, Drafting, Electricity, Assaying, Agriculture. The course in agriculture at this school has been very carefully worked out. At the present time there is but one class in the subject, the members of which are juniors. The text used is Warren's "Elements of Agriculture." There is an enrolment in this course of 21 students, which is about 7 per cent of the total enrolment. At the beginning of next year another course will be added in accordance with the schedule already mentioned; so that the percentage enrolment will no doubt be considerably increased.

The school has also undertaken to conduct an experiment farm. A plot of 27 acres has been purchased just outside of the town at a cost of $16,000. It was being plowed and fenced when I was there last November. The plans of the school work and of the management of this plot have been so carefully worked out by the principal and the instructor in agriculture that I give them herewith in full:

BAKERSFIELD, CALIFORNIA, June 7, 1910.

To the Honorable Board of Education of Kern County.

Gentlemen:—As a result of the consideration we have given to the subject of agriculture during the past year and from the conferences we have had with Dr. Leroy Anderson, with due attention to the objects and conditions to be met, we have reached the following conclusions:

The Kern County High School can conduct an experimental farm

with profit to its students and to the agricultural interests of Kern County.

To accomplish this result the farm should be planned to meet the conditions and tendencies of agriculture in this county.

The tendency in this county is toward the growing of forage crops, alfalfa in particular, and dairying.

The farm should, therefore, be large enough to afford room for demonstration work in the growing of field crops, and also large enough to support a small dairy herd. It should contain twenty acres, not less. It should be as good land as can be found. It should necessarily be as near the high school as possible.

Its objects should be several: to provide a demonstration field for students; to demonstrate better practical methods to farmers; to show them how the maximum yield may be obtained from the land while maintaining the fertility of the soil; to lead the way to better farm home-making; to improve the quality and yield of the chief crops of this locality.

As a field laboratory for students the farm should be used for the study of soils and soil fertility, for the practical application of the work in soil analysis which should be carried on in the school laboratories and the proper use of commercial fertilizers and green manures; for the study of the best varieties and the best methods of growing the field and forage crops of this locality; studying and measuring the amount of water needed by different crops and how water may be saved; to give the pupils some part in all the experimental work of the farm.

In order to instruct pupils in the best kind of dairying and to demonstrate it to farmers the farm should have a herd of ten cows. By beginning with a herd composed chiefly of grade cows and using only a pure bred bull the farm should illustrate how a dairy herd may be graded up to greater efficiency. The farm should have an up-to-date dairy barn and milk house planned for thorough sanitation and economy in handling. It should demonstrate at all times absolute cleanliness and convenience.

The farm should have two good work animals. By beginning with two good mares the breeding of first-class farm horses should be demonstrated.

For the purpose of illustrating the higher profit in better hogs and poultry, as well as demonstrating the best methods of handling them and preventing their diseases, the farm should have a few pure bred hogs and poultry.

The conduct of the farm should illustrate at every point intensive farming, that is, getting the highest amount of produce from the soil without reducing its fertility.

The farm should keep careful records of the cost of each kind of work, of the income from each crop, and of each kind of stock. It should keep exact records of the food used and the milk and butter fat produced by each cow. All these records should always be open to public inspection. They should be simple and should be used as illustration of the best methods of keeping farm accounts. The pupils should also be taught how to keep such accounts.

The farm should have an ideal farm house with modern plumbing and conveniences and a septic tank for the disposal of sewage. The object is two-fold. The house provides the necessary residence on the ground for the farmer in charge, and should illustrate to everyone a sensible, convenient and sanitary farm house. For this latter purpose it should always be open to inspection. It should have the septic tank to illustrate an inexpensive and safe disposal of sewage on a farm.

The farm should have a pumping plant for domestic supply and for irrigation purposes in order to render it independent of other users of water.

By experimenting with varieties of the principal crops of this locality and by following careful seed selection the farm should improve the quality and yield of the chief crops of the region. Such experimental plots can be made small in size and large enough in number to be of real value to the farmers of the county.

From these conclusions it may be seen that we believe that the value of the farm as a concrete illustration to the farmers of this county will be at least as great as its value for the purpose of instructing pupils. As a permanent living exhibit we believe it can be made to pay a solid return in dollars and cents to this county in increased profits from better methods and better crops.

In the same way I believe the instructor in agriculture can be fully as useful outside the school as in it. I do not believe he should have anything else to do in the school but handle his agricultural classes and direct the farm work. I think he should be free to get out among the farmers, get acquainted with them, help them wherever possible, get them interested in improvement, and bring to their attention any good thing to their advantage. In my opinion as much can be done in this direction to advance the interests of the county as in any other.

This outline, necessarily brief, is submitted in the hope that it will

have the examination and criticism of the chairman of the Board of Supervisors, whose recent visit to the agricultural schools of Germany should give his judgment great weight in any plans which may be formed.

Subjoined is an estimate of the cost of equipping and maintaining such a farm as that above described:

Dairy barn, with concrete floor and necessary drainage, hay storage and shed room for horses		$2,000.00
Cows—Eight grades at $50	$400.00	
Two pure bred at $200	400.00	
		800.00
Hogs—Three pure bred		60.00
Poultry		50.00
Sheds for hogs and poultry, including fences		200.00
Silo		300.00
Milk house		700.00
Milk house equipment—One 2 H. P. boiler	$ 75.00	
One separator	100.00	
Milk cans	20.00	
Milk vat	60.00	
		255.00
Two pure bred mares		600.00
Pump and motor		200.00
Well		100.00
Concrete pipe for garden plots		225.00
Tank for domestic supply		200.00
Farm equipment—Wagon	$100.00	
Harness	30.00	
Mower	65.00	
Rake	35.00	
Plow	15.00	
Harrow	15.00	
Cultivator	10.00	
Spading harrow	45.00	
Tools, etc.	150.00	
Manure spreader	250.00	
Fertilizers	125.00	
		840.00
Modern cottage with septic tank for sewage disposal		2,500.00
		$9,030.00
Annual maintenance		2,500.00

Respectfully submitted,

BENJAMIN MACOMBER.

[NOTE: The above estimate does not include the original cost of the land. In order to show the actual expenditure to date and the pro-

posed outlay for next year, the following statement has kindly been furnished by the school officials. E. B. B.]

Kern County (Bakersfield) High School—Equipment for agriculture as per inventory, June, 1911:

27 acres of land and buildings		$16,000.00
Pumping plant		675.00
Ten-inch concrete irrigation system		700.00
Farm tools—One harrow	$ 25.00	
One plow	17.50	
One large plow	65.00	
One spading harrow	55.00	
One mower	62.50	
One hay rake	42.50	
One grain drill	35.00	
One manure spreader	175.00	
One walking cultivator	9.50	
Garden tools	45.00	
		532.00
Farm fence		200.00
		$18,107.00

Proposed equipment for next year:

Green house	$ 300.00
Dairy barn	2,000.00
Creamery	1,000.00
	$3,300.00

In some schools the experiment station idea receives little or no attention. At Fresno, where there is a special instructor in agricultural subjects, there is no land devoted to such purposes. In other localities the experiment station looms larger than any other aspect of the subject. The Gardena school owns 12 acres of land, all under irrigation. Some of this land is being used at the present time for school gardens; and incidentally, these gardens here are especially well planned and taken care of. It is intended to use the entire acreage either in connection with the school work, or for experimental purposes. The Oxnard High School owns a lot of about three acres, and will carry on systematic experiments there.[4]

An experiment station is a large responsibility. To secure results that shall be really valuable, it is necessary to have a man who is fitted by training and temperament for this kind of work. As a rule, the

[4] See Report, p. 44.

school must utilize its agricultural man in the class room; and the good pedagogue may not be good in original research. That, however, is not the most serious objection. In a university the instructor is stable; he is not subject to the caprice of a school board or a body of citizens. He accepts his position with the expectation of holding it a long while. In the high schools—at least in most of them—conditions are different. It is not easy to foresee how this problem will be adjusted. That there are great possibilities in the idea there can be no doubt. A glance at one specific example will abundantly show this fact.

Tuolumne County inherited the traditions of the days of '49. It was first settled by miners. The towns were built in the vicinity of rich diggings. The newspapers of the county still point with pride and hope to the annual gold production of the county. Fifteen years ago the railroad came into the county, and soon thereafter lumbering became one of the leading industries. In the meanwhile the old, neglected apple orchards continued to bear delicious fruit year by year; and finally some progressive farmers noted the fact that the colored apples were especially fine in color and flavor.

That was the beginning of a new industry. Men began to plant orchards. The water that had been carried long distances through ditches to the mines was turned into the orchards; and the process of development went forward.

But in the meantime, the fact was developed that Tuolumne County had its problems in apple culture; has them, in fact, at this time. Therein lies the opportunity of the experiment station. Sonora is the county seat. All roads lead thither. There is a county high school in the outskirts of the town, where land is available. It is the only high school in the county. An experiment station, located there, in charge of a competent man, would be of great value. In addition, this man could coöperate with the high school authorities in working out a course that would put the boys of Tuolumne County in touch with what really is being done in the matter of scientific agriculture.

In all the schools where agricultural work is being undertaken there is an obvious desire to coöperate with and be of greater service to the community. This is as it should be. "When we consider the matter seriously," says Dr. Anderson, "it seems incongruous that a high school in a small town, surrounded by a rich agricultural territory, should be devoting all its money and energy to instruction in language, history, mathematics, and a little science, with not a word or thought of the industry which gives the place its being, and with

no correlation between the subjects taught and the live, throbbing heart of the whole community—its agriculture."

This coöperation does not confine itself to the class room; that is the best part of it. In every high school where a distinctly agricultural instructor is employed, this instructor spends a part of his time among the farmers. Thus, at Imperial, the instructor goes out every afternoon into the country, where he meets the farmers, becoming acquainted with their problems and with them, assisting them wherever possible. The same is true of the instructor at Stockton, at Bakersfield, and at other places. Great good will result from this mutual acquaintance and interchange of ideas, not only to the farmer, but to the instructor as well. The instructor under such circumstances lives among people as well as in their midst.

The agricultural instructor by the very nature of his work is forced to remain in the student class. He is not in the position of the teacher of algebra, English, or history, who covers the same ground year after year, and to whom growth, if not arrested, is at least not given so great encouragement.

The very contrary is the case. The agricultural instructor is subjected to a constant process of examination. On the one hand his work in the class room is being watched by his colleagues, who regard his course as in the nature of a laboratory experiment; and on the other the practical aspects are being questioned by the farmers and farmers' sons with whom he comes in contact. Said one person to me, speaking of a certain instructor: "He is a good teacher, but he is from the East, and unacquainted with California conditions." As a direct consequence, this man realizes that he must modify what he learned in an eastern institution concerning balanced rations; he must always be ready to change previously formed opinions. There is a certain advantage in having the expert agriculturalist in the high school; for he is close to the people, and hence more intimately in touch with the test that must be finally applied to all his work.

There is always a danger in over-emphasis. "My agricultural class expected that by some sort of magic they might become rich without work," said one instructor to me. "Some of them wanted to drop out as soon as they found that they were expected to use a spade." These same youngsters were soon disillusioned; and now they have a well prepared school garden, where they are studying at first hand the effects of fertilizers, of different methods of cultivation, of frequent and no cultivation, and so forth.

IMPORTANCE OF GOOD EQUIPMENT.

Agricultural education that is worthy of the name requires equipment; perhaps more than any other high school course. I am aware of the things to be said on the other side. I recall one school where the cash outlay had been very small. The work was done by the students—as it should be. The instructor had *created* his laboratory out of the raw material at hand; boxes and implements and a plot of ground. The results were very good indeed. There is such a thing also as the appropriation habit. Carried to an extreme (as it sometimes is) it kills the spirit of true education. But after all is said the fact remains that equipment is an absolute essential.

The most expensive item is the experiment station; that has already been referred to. Special apparatus is necessary for the different courses. For dairying, the Babcock test apparatus is of course indispensible; and other equipment sufficient to carry on ordinary dairy practice is desirable.[5] In all the classes there should be an adequate supply of tools, as well as illustrative material; and the teacher will be seriously handicapped who does not have a good agricultural library at his command. This latter need not, of course, be extensive. A select list of recommended books is given in Appendix B of this report. Many of the schools have greenhouses; indeed, that seems to have been one of the first items considered. These greenhouses cost from $10 to $250, depending on their simplicity or elaborateness, and the amount of student labor utilized in their construction.

THE AGRICULTURAL SUBJECTS.

What is meant by "agricultural instruction?" It is a fact that of twenty-one classes visited, and in which agriculture was a large if not the predominating feature, eight were called by other names. There were six classes in general science, and two in botany. Of the remaining, seven were designated general agriculture, three horticulture, one livestock, one livestock and dairying, and one dairying. Thus it is seen that more than one-third of the work here indicated, while agricultural in nature, does not appear as such in the schedule of exercises.

General Science.

The University is partially responsible for this. In its outline of the general science course, it clearly indicates that the work shall be

[5] See recommended lists, Appendix A.

directed toward a consideration of the things close at hand on the farm. "The course," says the Circular of Information, "should deal with such elementary scientific principles as are involved in gardening, including a study of soil and elementary physiography; household operations; sanitation; simple machinery, including the steam engine, the weather, the change of seasons, and similar natural phenomena." If the training of the instructor in botany has been along agricultural lines, it is easy to see that he will give the economic aspects of the subject the greater emphasis; the course adapts itself very naturally to the teaching of many of the most important considerations involved in farming.

General Agriculture.

In one school, the instructor in general agriculture is using a text "Agriculture for Schools of the Pacific Slope," by Hilgard and Osterhout; he does not, however, confine himself to it entirely, but makes extensive use of the bulletins of the United States Department of Agriculture. In this case the class consists of first year pupils. When the above named text has come into use in the grammar schools of the county, this arrangement will not be advisable if general science is required. In the other schools this course is given to second, third, or fourth year pupils, and the instructors follow the outline of of work given in Warren's "Elements of Agriculture," while the majority of them depart from the text in many essential particulars.

Dairying.

In one school dairying is combined with general agriculture, and occupies about a month or six weeks. In other localities where conditions warrant its introduction, it is treated as a separate course, as provided for in the admission requirements of the University. It is an excellent course. I have had opportunity to observe it at first hand. Every afternoon as I am writing this the boys in the dairy laboratory down-stairs are testing milk from the farms in the neighborhood. I have watched the class with a great deal of interest, with a view to determining both the good and the unfavorable aspects of the course. I am bound to say that I find the latter almost entirely absent. The students are keenly interested in their work; partly from the fact that it will be of money value to them; partly because through it they are coming to see the larger aspects of something they were already familiar with. I find also that the community is taking note of the

work of the class. Samples of milk and cream are sent in occasionally to be tested. Their high school work is making of these farmers' boys more efficient farmers, and hence better citizens. Nor is that all; the work in the laboratory has shown the students some arguments in favor of taking other sciences, such as chemistry. Thus the course has advantages that were at first not suspected.

Horticulture.

The classes in horticulture show a wide diversity of procedure. One instructor gives under this title much of the material given in the general agriculture course of other schools. At the Gardena school, the instructor has prepared a definite plan for the work in horticulture. He gives in the laboratory considerable practical work in budding and grafting; he also outlines to the class the entire plant kingdom in some detail as to families, mentioning especially economic and ornamental plants; he spends some time in a study of plant diseases and pests, treatment of grounds, etc. This course as he has outlined it, follows that given under the admission requirements of the University: "The study includes the fruits and vines of California, and especially of the individual pupil's home region, as to varieties, methods of growth, cultivation and marketing. At least one-third of the exercises should be laboratory or field work, covering propagation by the different methods of budding, grafting and layering; examination of insects and fungus diseases; mixing sprays and spraying; pruning and treating wounds; planting, cultivating and irrigating trees and vines, gathering and packing fruit; decorating home and school grounds with shrubs, trees, vines and flowers."

It is not always possible, for various reasons, to introduce agricultural courses at once into the curriculum. As already stated, however, it is easy to so modify other courses that they contain much reference to agriculture. I have before me Circular No. 24 (Rev.) of the Office of Experiment Stations, U. S. Department of Agriculture. It is entitled "Free Publications of the Department of Agriculture Classified for the Use of Teachers." Under the heading, "Publications Adapted to Teaching Chemistry," I find this list of titles of publications:

Commercial Fertliizers.

The Liming of Soils.

Alkali Lands.
Important Insecticides: Directions for their Preparation and Use.
Industrial Alcohol: Sources and Manufacture.
Leguminous Crops for Green Manuring (A Source of N in the Soil).
Harmfulness of Headache Mixtures.
Potato Culls as a Source of Industrial Alcohol.
Papermaking Materials and their Conservation.
The Determination of Total Sulfur in Organic Matter.
The Use of HCN for Fumigating Greenhouses and Cold Frames.
Acid Soils.
The Present Status of the Nitrogen Problem.

Similar lists are given for the use of teachers of botany, domestic science and hygiene, geography, physics, physiology, and zoology (including entomology). These indicate the opportunity open to the teacher to incorporate material of practical interest into the regular science courses.

One high school course has been neglected in this regard to the disadvantage, I believe, of the farmer and of the course itself; I refer to bookkeeping. Every system that I have examined to date deals with some form of business with which the majority of students never come into contact. There are copious sets for practice, dealing with wholesale and retail merchandise, with banking, and with many other forms of business; but when I desired, a few months since, to obtain trial sets illustrating bookkeeping on the farm, I was able to learn from publishers and instructors of only one book containing what I wanted; and that is not yet off the press. Here in the Imperial Valley there are at the present time between two and three hundred students in the high schools, and the commercial course has its full quota. Of these very few will ever work in the stores, and fewer still, of course, in the banks. Many of them on the other hand are intimately concerned with farm affairs, and could greatly assist in systematizing the accounts there if their attention were called to the matter. Well-kept accounts would work a great good to any farming community, and the high school can do much to introduce them. To be sure, the principles of bookkeeping hold true for any business, and the sets used in class are for practice only. But in reality the class-room work is establishing a groove, and bookkeeping should be frankly recognized as intimately connected with the chief business of the community, which is in most cases its agriculture.

[Another subject, which may be correlated in part with agriculture with mutual profit, is mechanical art. In Fresno High School plans have already been made for accomplishing this. E. B. B.]

OBJECTIONS TO THE INTRODUCTION OF AGRICULTURE.

A great deal may be said in favor of agriculture in the schools. There are also some arguments on the other side. The problems that arise must be met sooner or later; better, therefore, sooner. Chief among these is the administrative problem. The high school has been called upon within a few years to vastly increase the scope of its work. There is a wide-spread demand for the so-called commercial courses; manual training, also, has necessitated a well-equipped laboratory and a special teacher. Some of the larger schools, indeed, cause one to pause and to wonder what, after all, is a high school and what a university.

The demand for agricultural men is greater than the supply; so that, although they may teach without the special post graduate year of work required of most other instructors, they are able to command a salary much higher than the average. Not every school by any means can afford to undertake the work; at least not to the extent of employing a special instructor.

There is another possible objection. In the smaller schools, and indeed in those of average size there is a constant tendency to increase the number of classes at the expense of their size. Now, there is a very real disadvantage to the student in being in a class that is too large; there is a disadvantage no less real in the class that is too small. The principal realizes when he introduces a new subject that he must provide an adequate class in that subject. The special instructor feels that a great deal depends upon this factor, and wishes to secure the best class possible. The other classes may and no doubt sometimes do suffer as a result. These may seem to be trivial considerations; but they are very real when applied to the average case in point.

AGRICULTURE IN THE HIGH SCHOOL CURRICULUM.

Many people question with earnestness and sincerity the wisdom of introducing agriculture into the schools in any form. They point out that the demand for it is expressed by comparatively few people, while the great majority are, for the most part, indifferent. And they are right. There is no virtue in introducing a subject because it is new, or because it appeals for the time being to a limited class of people.

But the question is vastly larger than that. Reduced to ultimate

terms, it deals with the very foundations of the educational system. Briefly, the main point is this: Has the educational system come to its fullness of stature, or is it still in a process of evolution? There can of course be but one answer. The problem that remains is to determine what direction that evolution shall take.

The unique position of the American high school has been indicated so often and discussed so ably that it were superfluous for me to call attention to it here. There can be no doubt that it is undergoing a great change. It is in the midst of a mutation period. It served for many years primarily as a preparatory school for the university; only recently has the fact been generally emphasized that its real duty is not to the small percentage who go from it to the university, but to the community in which it lives, to the vastly larger proportion of boys and girls whose education will cease with it. The university is fully cognizant of this change of objective; witness the recent act of Harvard University in greatly modifying its entrance requirements; or the University of California, in the liberal allowance of credits it makes for vocational subjects.

However, the high school is not destined to become merely a training school. The thinking of the composite citizen is not always in clearly defined terms, but this same composite citizen realizes too deeply the beauty and the efficacy of education, to permit that. The best part of agriculture is not always the agriculture, nor is the dollar-sign motive the only one that arouses *and sustains* the student's interest. From the "practical" questions—analysis of soils, methods of cultivation, the judging and breeding of animals, and the chemistry of fruits—from these "practical" subjects the judicious teacher leads the student into the presence of those eternal laws which reveal in a moment of time all the wonders and mysteries of the formation of worlds.

There is yet another aspect. An education must be more than a memory process. The ability to pass a good examination is not the final test of ability to face the problems of life. Nor is a well-trained mind, important as that may be, the only criterion of ultimate success. The processes of education must be examined by a standard much higher than that. If the present system absorbs only a portion of the thought and interest of the student; if the work of the class room is in many cases only a veneer, which will ultimately show itself as such; if, in the final summing up, the student is often poorer, not richer, as a result of his days in the high school—then it is time to consider the matter carefully, and cast about for a remedy. The whole situation

must be faced frankly, with open mind. There are many factors to be considered. But some loom larger than others, and carry especial weight.

We may as well recognize the fact that the high school student is not a grown man. When he enters he is a trifle over fourteen, sometimes not so old. He has just awakened into a new world, or will soon do so. The problems of the man of thirty or forty-five are not his problems; the educational system suited to the scholar, of mature years, engaged in the work of original research, is decidedly not suited to him. The long hours spent poring over books are storing his mind with facts, and training his mind in the formation of right habits of thinking; but they are not helping him to solve the problems of a newly awakened consciousness. The ability to demonstrate a proposition in geometry will be of service in all his work, of whatever nature; but his body, as well as his mind, calls for incessant exercise; and he will not be rationally developed unless that exercise be given.

I do not know what future is in store for agricultural education in the secondary schools of California. I know that it will not stand still; I know it cannot. It will either deteriorate, and soon disappear altogether; or it will go forward and become an agency of more value than its most ardent supporters at present dare hope for.

The California high schools are face to face with a momentous situation. Last year there were enrolled throughout the state a total of 39,115 students. Of these, 18,424 were freshmen and 4,960 were seniors. Only one-fourth of those who enter the first year continue until the fourth year.

To my mind I saw nothing more hopeful in all the schools I visited than a lath house at Gardena built by the students themselves. The building was carefully planned before any work was performed. Then student foremen were selected, who familiarized themselves with what was to be done. On a given afternoon all the students were put at work, under the direction of the foremen, and the building was soon completed. These students have accomplished other tasks which the school needed done, thereby learning many lessons not taught in the class room. Athletics are good and necessary. But many contests would not teach as much concerning the essential dignity of all labor, or the care of public property, as did the work involved in the construction of that one lath house. It is not likely that there will be any sudden tendency on the part of the school authorities to call upon the students of the schools to construct buildings and lay out walks or do any other work which at the present time is performed by hired

laborers. The nature of the work and the personality of the principal have much to do with the successful carrying out of such undertakings. But it may be possible that in the not distant future students will recognize that the manual labor involved in plowing or hoeing is as much a part of a study of soil texture as the use of a microscope or a crucible in the laboratory.[6]

The problem of the adolescent is not an easy one to solve. Certain it is that no solution will be worked out in a month or a year. That character is of infinitely more worth than any other product of education—that all others are indeed by-products only—is a fact so self-evident as to be axiomatic. But the statement of the fact does not carry one very far in the solution of the problem. I believe, however, that the introduction of agriculture into the high schools is a step in the direction of final solution. To use a figure, the mountain peak is visible, and a portion of the way is discernible. The question remains, What are the first steps to be taken?

I think there are two. The first deals with the administrative unit. For the successful working out of a system of agricultural education, the present high school district is too small. That fact is borne out by the best experience in the East as well as in California. I have already spoken of the fine work being done by the high school at Bakersfield—a county school. Very few schools are able to do with great effort what it accomplishes with ease. In several states the difficulty has been met in the same way. In Wisconsin, agricultural high schools are established and equipped at the expense of the several counties, while the state aids each to the extent of $4000.00 per year, to be applied to the running expenses. A similar provision is made in the laws of Michigan, Oklahoma, Arkansas, Minnesota, and most of the southern states; though of course the details of administration differ.[7]

Thus far the State Legislature of California has manifested its interest by establishing and maintaining two state schools—the School of Agriculture, Mechanics and Household Arts at San Luis Obispo, and the University Farm School at Davis. Each school is doing first class work; but it is obvious that these alone cannot serve the whole state; and the Legislature must either continue this policy and establish other similar institutions throughout the state, or make some other provision whereby they may be established by the different communi-

[6] See Report, p. 44.

[7] See pp. 20–26, Cir. No. 106, O. E. S., U. S. Dept. of Agriculture.

ties as these communities so desire. It seems likely that the latter policy will of necessity be adopted. When that is done, agricultural education will be given a great impetus in the secondary schools; for the most serious objections will thereby have been removed. [This should not be construed as an argument against small high schools introducing agriculture in so far as they deem practicable or correlating their science work therewith; nor against the establishment by the state of one or two more special agricultural schools. But the efforts of the smallest high schools to meet the demand of the community, that agriculture be taught, are frequently pathetic as well as praiseworthy. The *trouble* is with the size of the administrative unit. We have *too many* high schools in California. There is no justification for attempting to maintain complete high schools in two villages four miles apart, when the present total enrolment is only seventy-five and the prospect for future increase only ordinary. One strong institution, for the three upper grades at least, will always be able to serve both communities better than two weak schools with poor facilities. Another desirable step is coöperation between nearby schools for the purpose of teaching agriculture. With present means of rapid locomotion, a teacher could spend half of each school day in two different schools situated only a few miles apart. This would be very desirable when both schools could provide proper equipment. E.B.B.]

The second step concerns the University of California, and specifically, the College of Agriculture. The instructor is and will continue to be the crux of the whole matter. If he be mediocre, the subject will never be a success. If he lack knowledge of agriculture, he will not receive the coöperation of the farming community. If he does not possess the instinct and to some degree at least the training of a teacher, he will not have the coöperation of his classes. The responsibility of the University is unmistakably clear. On it must rest the duty of preparing not only well-equipped agriculturists, but efficient teachers as well. It is the fountain head which will determine the character of the whole stream.

To be sure, some instructors will be secured from other states, and some will go directly from the state high schools already mentioned. For although these schools (especially the one at Davis) are actually secondary schools, they share, in many important particulars, the point of view of the University. Still other teachers will secure their training in the normal schools. But the fact remains that the University of California will be regarded chiefly as the source of supply. In a very real sense, the future of agricultural education in the secondary

schools rests with the College of Agriculture of the University of California.

[The favorable attitude of the University of California toward the development of public school agriculture in California has been mentioned in connection with the high school phase. The Regents of the University have indicated their desire to foster its development by the appointment of three instructors in Agricultural Education in three successive years and the total appropriation to date of $5000 to defray the cost of publication, traveling and equipment. With these facts in mind we may surely conclude that the University will never oppose the proper development of agricultural instruction in the school system of the state, but rather that it will endeavor to do its share in directing this development by training teachers and furnishing suggestions or advice as the need arises; also that it will continue to encourage and help in the development of secondary education in all its phases including extension in scope of work both downward to form intermediate high schools and upward to establish continuation courses. Upward extension in scope of the high school (often referred to as the organization of the junior college), should not aim primarily to provide courses equivalent to all those offered in the first two years at the University. The chief function of the junior college must be as much to extend the reach of the high school as to prepare for entrance to the junior class at a university. The subjects offered in the junior college should be of such a nature that they may be utilized for a final or finishing course for all who do not expect to attend a higher institution. Prominent among these should be the vocational subjects represented by more advanced studies which will be preceded by the science and elementary vocational studies of the regular high school course. E. B. B.]

"The subject of paramount importance in our correspondence and in the hearings is education. In every part of the United States there seems to be one mind, on the part of those capable of judging, on the necessity of redirecting the rural schools. There is no such unanimity on any other subject. Everywhere there is a demand that education have relation to living, that the schools should express the daily life, and that in the rural districts they should educate by means of agriculture and country life subjects. It is recognized that all difficulties resolve themselves in the end into a question of education."—From Report of the Roosevelt Country Life Commission.

STATUS OF THE COURSE OF STUDY.

By E. B. Babcock.

In order to summarize that portion of the foregoing discusson which deals with curricula and subjects, the following plans for sequence of subjects in natural sciences and agriculture are given. They probably indicate present general practice as accurately as any condensed statement could do.

Grade.	*Natural Science.*	*Agriculture.*
9	General Science or Physical Geography.	(General Agriculture).*
10	Botany or Biology.	Live Stock, one or two semesters. Poultry, one or two semesters.
11	Chemistry.	Horticulture, one or two semesters. Dairying, one or two semesters.
12	Physics.	Soils and Farms Crops or General Agriculture (Synthetic).

It should be noted here that the smaller high schools will not be able usually to offer all the subjects in the above lists. For the average school the following selection will probably be most satisfactory:

Grade.	*Natural Science.*	*Agriculture.*
9	General Science or	General Agriculture.*
10	Botany or Biology.	
11	Chemistry.	Horticulture or Dairying, or both.
12	Physics.	Soils and Farm Crops or General Agriculture includ. Livestock.

As an illustration of what is being attempted in a large school which is part of the system of a great city, the following plan is of decided interest:

* In high schools receiving grammar school graduates who have not studied agriculture.

PROPOSED COURSE IN AGRICULTURE AT GARDENA AGRICULTURAL HIGH SCHOOL.

	First Semester.		*Second Semester.*	
First Year—		Hours		Hours
	Botany	10	Botany	10
	Carpentry and Mech. Drawing	10	Carpentry and Mech. Drawing	10
	English	5	English	5
	Algebra or Practical Arith.	5	Algebra or Practical Arith.	5
	Music or Oral English	2	Music or Oral English	2
Second Year—				
	Zoology	10	Economic Entomology	10
	English	5	English	5
	Forge or Cabinet Making and Mechanical Drawing	10	Forge or Cabinet Making and Mechanical Drawing	10
	Plant Diseases	10	Landscape Gardening and Forestry	10
	Music or Oral English	2	Music or Oral English	2
Third Year—				
	Horticulture	10	Horticulture	10
	Poultry Culture	2	Dairying	10
	Farm Accounts	3	Chemistry	10
	Chemistry	10	English or Spanish or Latin, or Geometry, or Stenography and Typewriting, or History	5
	English or Spanish or Latin, or Geometry, or Stenography and Typewriting, or History	5	Music or Oral English	2
	Music or Oral English	2		
Fourth Year—				
	Soils and Fertilizers	10	Farm Crops and Management	10
	Rural Law and Economics	5	Rural Law and Economics	5
	Civics and History	5	Civics and History	5
	Physics or English or Spanish or Latin, or Geometry, or Stenography and Typewriting, or History	5	Physics or English or Spanish or Latin, or Geometry, or Stenography and Typewriting, or History	5
	Music or Oral English	2	Music or Oral English	2

REPORT OF AN EXPERIMENT IN AGRICULTURAL EDUCATION AT OXNARD UNION HIGH SCHOOL.

By HERBERT LEE, M.A., Principal.

REASONS FOR THIS REPORT.

High school courses in agriculture are so new and so largely therefore in the experimental stage, that it seems worth while to make a careful record of what has been done here in Oxnard. Our experience will thus be available for purposes of comparison and criticism. Only by careful critical study, much experimentation, and burning enthusiasm, can the teaching of agriculture as a regular subject in the high-school curriculum be made not only popular among students and of interest to their parents, but effective and practical for purposes of scientific training, information, and culture.

THE OXNARD HIGH SCHOOL AND ITS AGRICULTURAL DEPARTMENT.

In 1909 the Oxnard Board of High School Trustees decided to add a department of agriculture to their school. Oxnard is a progressive town, the fifth largest railroad shipping point in the State of California, the center of the lima-bean industry, and the home of one of the largest beet-sugar factories in the world.

The Oxnard Union High School District in the County of Ventura embraces eight districts with a total assessed valuation exceeding $9.300,000. The high school trustees therefore felt that their school should emphasize the agricultural side and they also felt that a proper expenditure of money to organize a successful department would be wise and would meet with the approval of the patrons of the district. They therefore negotiated for 2¾ acres of land diagonally across from the school grounds, and secured a special teacher to give agricultural courses. Mr. Hummel was that teacher, but he only stayed one year, for he was asked by the superintendent of Fresno to accept a position there. The principal of the Oxnard high school also accepted another position at the close of that year. I succeeded him and secured Mr. F. H. Bolster as teacher of agriculture to succeed Mr. Hummel.

THE AGRICULTURAL COURSES.

When I took charge of the Oxnard high school on July 1, 1910, it at once occurred to me that it would be better, at least for a year or two, to teach agriculture in connection with courses denominated general science for first-year students and botany for second-year students, rather than arrange courses called agronomy or vegetable-gardening. Many students, especially girls, were attracted to the courses of general science and botany, who would have felt that courses in agronomy and vegetable-gardening were not what they wanted. I also suggested to the instructor the wisdom of emphasizing other things in his general science course besides agriculture, and he has given his students several weeks very practical training in simple bacteriology, besides devoting some weeks to the subjects commonly taught under physical geography. Thus, the identification of the common rocks and minerals, the work of lateral pressure and volcanic action in building up and of erosion in tearing down elevations have been taken up during the year's work. At the same time, after the class had become thoroughly interested in the experimental character of the course, for no text-book was used, the emphasis was placed more and more upon the soil and the vegetable products of the soil. Many experiments were performed to determine the porosity, the humus-content, and the chemical constituents of soils; many more to develop the meaning of capillarity and the reason for constant cultivation to conserve moisture. The whole subject of dry-farming, so important in many parts of the state, was thus brought up. "Everything by experiments and actual observation, nothing from mere say-so": this has been the keynote to the method throughout, and with admirable results.

(For the courses in general science and agricultural botany as outlined by Instructor F. H. Bolster, see pages 39 to 41 of this report.)

PRACTICAL AGRICULTURE ON THE SCHOOL FARM AND GROUNDS.

In the fall and early winter outdoor work illustrative of the classroom discussions was carried out on the school grounds and in the glasshouse. As soon as conditions would permit, which was some time in January, individual gardens, 9 feet by 34 feet, were allotted to the students of the general science class. These gardens are situated on the school farm near the school, and are so arranged that they may be cultivated and irrigated under field conditions. The students

of the botany class are each given a plot on the same farm and subject to the conditions. Each student is assigned a different plant-family to study and experiment with, and selects when possible about equal numbers of species of flowers and vegetables. In addition to this individual work, the class grow eucalyptus, shade, and ornamental trees in a lath-house, raise fruit and nut trees from seed and perform the work of budding and grafting. Besides all this, the students have watched the preparation of half the farm for seeding of alfalfa. The land was leveled by means of a Bostrom's farm level. Panels were planted with ridges between. Three varieties of alfalfa were planted, namely, common, Arabian, and Turkestan. Some of each kind was inoculated. Finally each lot was sown in a different panel and each was carefully labeled.

STUDENTS' QUESTIONAIRES.

All this work, including experiments in the laboratory and field work on the school farm and grounds, has been most valuable. It has cultivated close observation of plant and animal life. It has developed reasoning power along lines of value. Moreover, the work is interesting.

To find out just what the students thought of these studies, both of the general science and the botany, I made out sets of questions for each class and tabulated the replies. These, both questions and answers, may be found on pages 35 to 38 of this report, and to those interested in this subject they will, I am sure, be very pleasant reading. At the end of each set I have drawn inferences that I feel are fully justified.

The replies of the students are peculiarly gratifying because in many respects the work has been unnecessarily difficult and arduous. The school farm had to be got into shape and considerable preliminary work done both on the farm and the school grounds. Now that we have our land fenced, leveled, irrigable by our own artesian well bored this year, and in excellent cultivation, the work of future classes will prove pleasanter because less laborious.

COST OF FARM AND EQUIPMENT.

Our farm and its equipment have been secured at very reasonable expense. (See the financial statements on pages 33 to 35 of this report.) All told, we have spent so far $3600 for permanent equipment for teaching agriculture outdoors in connection with courses in general science and botany. This includes $2474.45 for 2¾ acres of land

within the Oxnard city limits. An artesian well has been bored on the farm and capped for irrigation purposes. It gives an abundant flow of water and is considered one of the very best wells in Ventura County. It cost in all $517. Fencing the farm with "American" wire fence, together with two double 16-foot gates and one single 4-foot gate, cost in all for labor and material $231.66. This included the fencing of a pen, 80 feet by 100 feet, where a patch of morning-glory, the pest of this district, is located and which is to be experimented with and kept from spreading further and finally destroyed. Other improvements brought the total to $3600. A detailed statement of all expenses included in this sum is given on pages 34 and 35 of this report, and this detailed account has been condensed for greater convenience on page 33.

In addition to this expenditure of $3600 for permanent equipment, we have spent $84.16 for running expenses, which might be comprised under two heads, labor and supplies. (See page 34.)

Further, a practical botanical laboratory with seed cabinet, laboratory tables, microscopes, library, relief maps, instrument sets, etc., has been equipped for $633.58. (See page 34.)

COMPARATIVE ENROLMENT AND EXPENSE.

The questions are sometimes asked: How many are taking this course? and Is the expense justified?

I have taken some pains to answer these questions fairly. Agriculture is a new subject and one must be careful to distinguish between permanent equipment and running expenses. For purposes of comparison, we must not confuse them. The statistics on page — answer the question of expense; those on page —, the question of enrolment. The tables speak for themselves; little comment is necessary. Suffice it to say that thirty-six out of a total of ninty-four students, or 38½ per cent of the whole school have been enrolled for either general science or botany, the courses that include work in agriculture, and that, at least in our school, general science and agricultural botany cost less than half per student what chemistry and physics cost (counting running expenses only).

STRONG DEMAND FOR TEACHERS OF AGRICULTURE.

So strong is the demand for good teachers of agriculture, that it is difficult for a small instituton to keep one long. Mr. Hummel stayed here only one year and then accepted—what he considered promotion—

a position in the school department of Fresno. Mr. Bolster, after being with us only one year, is leaving to take up work on the staff of the University Farm School at Davis, but we hope that we have found an able successor to him in Mr. J. E. Gore, who comes to us strongly recommended by the authorities of our State University.

ENCOURAGING FEATURES.

The community's liberal support, the trustees' hearty coöperation, the conscientious teacher's expert services, the students' interested attention—these are things that have made our agricultural experiment so far successful. The coming of the Demonstration Train, the visits of professors from the State University, the wide interest manifested in our work as shown by letters received from many teachers and other officials—these things have stimulated us to persevere and do our best. That this report may help on the cause of education along the lines of scientific agriculture is the hope of the writer.

EXPENSE (CONDENSED) INCURRED UP TO MAY 1, 1911.

For Permanent Equipment for Teaching Agriculture in Connection with Courses in General Science and Botany.

2¾ acres land		$2,474.45
Well on same		517.00
Fencing same		231.46
Leveling same		118.00
Buildings on same:		
1. Glass house (approximate)	$200.00	
2. Tool-house moved	5.00	
3. Mushroom house	28.32	
4. Lath-house	8.00	
		241.32
Tools, farm level, etc.		101.60
Seeds, plants, etc.		41.32
Piping from well to pen (estimated)		20.60
Manure for gardens, nursery stock, etc.		35.25
Plowing and harrowing in alfalfa		9.00
		$3,790.00

N. B. All of this except $810 was spent this year. The school board of January, 1909, however, by contracting to purchase the land for $2,474.45 practically added this department to the school. The present administration had either to go back on this step or go ahead and make arrangements to improve the land purchased, and make it serve the purposes of education. They did the latter.

ADDITIONAL *PERMANENT* INDOOR EQUIPMENT FOR TEACHING GENERAL SCIENCE AND BOTANY.

Before July	1, 1910—Library		$ 40.00
Dec.	15, 1910—Botany Laboratory		410.00
Feb.	24, 1911—12 instrument sets		10.50
Feb.	24, 1910—2 relief maps		30.00
April	20, 1911—11 microscopes		67.43
Jan.	17, 1911—Dishes, pans, etc.		20.00
July	1, 1910, to July 1, 1911—Library		50.00
April	4, 1911—1 gross vails (Bacteriology)		1.70
April	20, 1911—Printed herbarium materials	$1.75	
	Card index	2.00	
			3.75
			$633.38

RUNNING EXPENSES FOR AGRICULTURAL WORK IN CONNECTION WITH GENERAL SCIENCE AND BOTANY.

Seeds, plants, etc.	$35.10
Dishes, pans, etc.	10.46
Herbarium slips and cards	5.25
Chemical supplies	15.45
Biology supplies	2.15
Day labor	18.75
	$84.16

EXPENSE (IN DETAIL) INCURRED UP TO MAY 1, 1911.

For Permanent Equipment for Teaching Agriculture in Connection with Courses in General Science and Botany.

Before July 1, 1910.

First payment on school farm	$800.00	
1 cultivator	10.00	
		$ 810.00

From July 1, 1910, to May 1, 1911.

Final payment on land and $1 for deed		$1,674.45
Well (a) boring and piping	$399.25	
(b) fixtures for same	7.75	
(c) capping well and fixtures	110.00	
		517.00
One Bostrom's farm level		15.00
Labor on mushroom house	$17.50	
Lumber for mushroom house	10.82	
		28.32
Manure hauled on farm		32.25

Leveling Farm.

Labor	118.00

Fencing.

Posts and braces	$56.67	
Fence, $81.52 and $5.60	87.12	
Labor	58.25	
Posts	29.42	
		231.46

Plants, Seeds, etc.

Plants, seeds	$11.97	
Plants, seeds	15.75	
Alfalfa seed	13.60	
		41.32
For tools and other equipments		86.60
For moving tool-house		5.00
Plowing and harrowing in alfalfa		9.00
Lath house		8.00
Piping from well to pen (estimated)		20.00
		$3,600.00

ENROLMENT TO SHOW PERCENTAGE DROPPED.

Subject	Enrolment	Dropped	Percentage	Reasons
Typewriting	44	10	22¾	1 too busy. 8 left school. 1 forbidden.
Bookkeeping	18	4	22	4 left school.
Shorthand	9	4	44	4 left school.
Freehand Drawing	20	2	10	2 left school.
Mechanical Drawing	9	2	22	2 left school.
General Science	20	4	20	1 left school. 1 incapable. 2 dissatisfied.
Botany	16	4	25	3 left school. 1 too much other work.
Physics	8	2	25	unable to do the work.

STUDENTS' OPINIONS OF THE GENERAL SCIENCE COURSE.

In order to get at what the students who are taking this course think of it, I made out a set of questions and asked for candid answers to be written out. The students knew the present teacher was leaving for a university position and answered quite frankly.

The questions with the answers collected and condensed are given below. The original papers are on file in my office and are interesting reading.

Question I: What part of the course in general science do you like best?

Number who preferred gardening work 8

Number who preferred inside experiments	1
Those liking it all (see quoted answers below)	5
	14

"I like the whole course."—Henry Abplanalp.

"There is not anything I have had in general science so far that I did not care for. It gives a touch or insight to do many things. I think it is all beneficial."—Edna Nichols.

"I like the inside (work) and outside both."—Mitford Crinklaw.

"I like it divided indoors and outdoors the way it is."—Hazel Milligan.

"I like any part of general science."—Lila Pederson.

QUESTION II: Do you think the outside work in gardening helps you to understand the subject better?

13 answered "Yes."

1 answered "Not sure, but liked it very much."

QUESTION III: Would you recommend your friends to take this course? Why?

7 answered "Yes."

1 answered "No."

3 answered All depends on what they care for.

1 answered It depends on what their career is to be.

1 answered I wouldn't advise. People are so uncertain in their likes and dislikes.

1 did not answer this question.

14

The following four answers are quoted in full:

"I would recommend them to take the course, for it is a very good course for every person to know."—George H. Lodwig.

"Yes, because it is so interesting."—Lila Pederson.

"I would. It gives one a chance to feel in all directions for what he wants."—Edna Nichols.

"Yes, because you can learn a great deal about things which come up in every day life."—Mattie Vickers.

QUESTION IV: Do you wish to take up botany next year with more work in gardening, and learn to graft and bud trees, and study plant life more deeply?

5 boys and 4 girls answered Yes.

1 undecided.

1 (girl) No.

2 No, because graduating. (One would take it, if she were going to come back).

1 No, because I must take mathematics and drawing for my engineering course.

—

14

QUESTION V: If you took up botany next year, would you rather work indoors all the time?

13 answered "No."

1, who is graduating, did not answer the question.

FAIR INFERENCES FROM THE ABOVE ANSWERS.

1. The work in general science has been both pleasant and profitable according to the students themselves—and that is saying much. The fact that most of them wanted to continue the subject next year is good evidence of this.

2. The agricultural work outdoors is evidently a valuable feature of this work.

STUDENTS' OPINIONS OF THE BOTANY COURSE.

QUESTION I: What part of the course have you liked best?

6 answered The garden work.

2 answered Grafting and budding.

1 answered The analyzing of flowers.

1 answered The indoor experiments.

—

10

QUESTION II: Has the study added to your interest in plants and flowers?

All answered "Yes."

Note the following answers:

"Yes, my interest as well as one or two members of my family. I have a nice little plot laid out at home planted with vegetables from the (school) greenhouse."—Josephine Morris.

"Yes, and I have started to work in my home garden."—Anna Horsley.

QUESTION III: Would you care for any more work of this kind next year?

(N. B.—This was the second year's work in science dealing largely with agriculture and in a school where nearly all the common high-school subjects are taught with a good equipment by good teachers. Negative answers therefore do not necessarily mean that the students dislike the work).

6 answered "Yes."

4 answered "No."

10

QUESTION IV: Can you make any suggestions for making this course better for the students who may take it next year?

9 answered "No."

1 answered as given below:

"I think it would be more interesting to have more experiments with flowers and more outside work."—Anna Horsley, average mark 95 per cent.

QUESTION V: Do you think the students could learn as much without the gardens?

7 answered "No."

2 answered "Yes."

1 answered "Yes, in a modified way." (See below).

The following answers are interesting:

(Negative) "No, I believe the garden work is quite essential for it fastens an interest in garden work and plant life."—Josephine Morris.

(Answer qualified) "Yes, but the garden work makes it more interesting."—Myrtle Wheldon.

QUESTION VI: Would you rather do more work indoors with the microscopes and classification of flowers and less outside work?

8 answered "More outside work."

1 (a Japanese) preferred the inside work.

1 likes both kinds equally.

NOTE.—The boy who answered question V in the negative, that is, that they could do just as well without the gardens, answered "No" to this question 6; the girl who said "No" to question V, said, in answering question VI: "I would rather work outside, provided we aren't given men's work to do."

FAIR INFERENCES FROM THE ABOVE ANSWERS.

1. The garden work outdoors is a valuable feature of the work.

2. The study has led to a greater interest in plant life and this interest has in some cases shown itself in the cultivation of gardens at home.

3. The work on the whole has been both pleasant and profitable to nearly all the members of the class.

SUGGESTIONS BY THE INSTRUCTOR, MR. F. H. BOLSTER.

To properly care for grounds, etc., more labor is needed than the janitor can give and than classes should give. Classes should have

about three days of laboratory work to two days of work outside. The outdoor work should never be more than the inside work. The teacher can not catch up all the extras. If he does the work of a day laborer outside, he will teach inside like a day-laborer, because too much physical labor makes study at night impossible, and a teacher can not do the best work without constant study.

Glass-house needs glass, wire on top, and heating provided for. A Petaluma brooder heater will do. Bulletin list needs to be made more complete and to be made more easily available. Lath-house should be built using materials now on hand plus some more. Wall-cabinet of plant diseases, insects, etc., would be a fine addition to equipment. A microscope cabinet is needed. A cabinet for school herbarium needed if new man does work in systematic botany. My idea was to make a school herbarium of weeds and economic plants of this section.

SCOPE OF THE WORK.

In the following pages the work is very briefly outlined.

General science is a course intended primarily for freshmen students. No text-book has been used. The work has been carried on mainly by experiments and discussion arising therefrom.

Agricultural botany is intended primarily for second-year students.

OUTLINE OF COURSE IN GENERAL SCIENCE.

The aim of this course is to teach the pupil by simple experiments how to draw correct conclusions from facts and to give a knowledge of the more important phenomena of every day life, particularly of the farm.

Some of the more common chemical elements are studied and a few simple compounds. This leads to elements necessary to plant food, tests for proteids, sugars, starches, fats, and the classification of vegetable products as to food content. In addition are studied conditions necessary for the germination of the seed and growth of the plant, such as heat, air in the soil, and the per cent of air space which should be filled with water; some common insects and the use of emulsions and spraying mixtures on plants; minerals and the formation and transportation of soil; capillarity as related to irrigation, retention of moisture, cultivation, aeration of soil, and the control of alkali; and bacteria in relation to the dairy, to nature's food cycle, and to disease.

Practical exercises are given in the rooting of cuttings, transplant-

ing, seed testing, drawing of plans for the beautifying of grounds, ordering seeds and plants, garden work and the care of tools.

During the second half-year on the individual garden plots the pupils grow vegetables and flowers which they irrigate and cultivate themselves, and in the care of which they put into practice some of the knowledge gained from laboratory experiments.

Careful preparation of note book is required. Each experiment is discussed thoroughly in class and the application either drawn from the pupils by question or given in a talk by the instructor.

Each pupil collects a private library of state and government bulletins and nursery catalogues which contain information relating to the cultivation of plants of his or her garden and prepares papers on the cultivation of the various plants.

They also make a collection for the school of insects and other pests or anything of an educational nature along the line of agriculture.

OUTLINE OF COURSE IN AGRICULTURAL BOTANY.

Texts—Experiments with Plants—Osterhout.

Flora of Los Angeles and Vicinity—Abrams.

First half-year practical experiments chosen from Osterhout. Many of these are performed by all the class, but most are special experiments performed by individuals. Whenever a practical experiment is suggested substitution of such experiments is often made, but the attempt is made to perform about one-third of the experiments of each chapter of Osterhout.

After any experiment is completed it is discussed fully in class and its relation to daily life, especially its bearing on agriculture is pointed out. Great emphasis is placed on this practical application of the experiment.

During the fall the class has the setting of bulbs on the grounds and general care of them and other plants. They also grow tender plants in hot-bed and greenhouse in preparation for garden work. A mushroom house is used and experiments carried on in the culture and study of mushrooms.

The second half-year is spent on school gardens and on systematic botany. The individual plots are 12 feet by 34 feet, arranged so that they may be cultivated and irrigated under field conditions.

Each individual garden plot represents the plants of a different plant family, the aim being to choose from the families representing an equal number of species of flowers and vegetables, though this is

not always possible. The families represented this year on the garden plots are Grass, Mustard, Legume, Composite, Parsley, Gourd, Nightshade, Mint, Pink and Poppy. Each pupil gathers a private library which consists of state and government bulletins and the catalogues of nurserymen which relate in any way to the cultivation of any of the plants of his or her family, and prepares papers on the plants with the help of this information and of the library of the agriculture department.

The class grow eucalyptus, shade and ornamental trees in a lath house, raise fruit and nut trees from seed and perform the work of budding and grafting.

They also carry on experiments in hybridizing, the special plant for this work being the guava. Seeds of this fruit for the work have been imported from an interior province of high elevation in the Philippines. The fruits of this guava measure nine inches in circumference. The parent plants were twenty-five feet in height and four to six inches in diameter.

The pupils collect and describe a certain number of plants for their individual herbaria, and also collect a school herbarium of economic plants, weeds and fungi.

Two things are aimed at and kept constantly in mind throughout this course in agricultural botany—to make botanical work teach agriculture, and to make the agricultural work teach botany.

ESTIMATED COST PER STUDENT PER SUBJECT.

Subject	Fraction of day	Salary Cost	Total Students Enrolled	Salary Cost per Student	Running Expense paid by School per Student	Same paid by Student	Total Expense per Student
Freehand drawing, first year	1/7	$214.00	8	$27.00	.....	$ .50	$27.50
Freehand drawing, second year	1/7	214.00	12	18.00	.....	.50	18.50
Mechanical drawing first and second year	1/7	214.00	9	24.00	.....	14.00*	29.00
General science	2/7	428.00	20	21.40	$ 6.00	.....	27.40
Botany	2/7	428.00	16	26.80	6.00	3.00	35.80
Chemistry	2/7	428.00	7	61.00	15.00	1.50	77.50
Physics	2/7	428.00	6	71.00	10.00	1.60	82.60

* $14.00—student's permanent equipment of mechanical instruments. Reckon $2.00 wear and tear each year.

PRODUCE RAISED ON SCHOOL GARDENS AS ESTIMATED BY PUPILS.

(Lettuce estimated in heads, all other vegetables in bunches.)

First-Year Gardens.

Name	Beets	Carrots	Onions	Turnips	Radishes	Lettuce
Henry Abplanalp	19	14	2	12	16	9
Ida Rowe, Mattie Vickers	12	7	3	6	6	28
Edna Nichols, Pearl Lamb	10	9	5	5	6	30
Lila Pedersen	9	9	4	1	16	7
Herbert Cohn	0	10	10	12	30	20
Diamond Prentiss	3	0	6	7	20	18
Hazel Milligan	8	3	2	6	25	15
John Gastl	20	12	5	10	15	16
Mitford Crinklaw	20	12	5	12	15	20
Nellie Donlon	10	10	20	5	20	20
Chas. Aggen	0	0	4	2	36	0
Albert Pratt	4	4	10	4	50	4
Mabel Crain	9	22	6	3	16	18
George Lodwig	8	11	5	11	50	13
Total	128	123	87	96	321	218

Other Vegetables Than Above.

	Cabbage Heads	Cauliflower Heads	Parsnips Bunches	Kale Bunches	Collards Bunches
Lila and Mabel	2	3	9	5	5

Most of the vegetables mentioned above were taken home by pupils and used, therefore saving the family the price they would have paid the vegetable man.

Allowing five cents per bunch and three heads of lettuce for a nickel, also counting cabbage five cents, cauliflower ten cents, parsnips nine bunches, and kale and collards together five bunches, the total amounts to:

$$828 \times .05 + .85 = \$42.25$$

The amount of space devoted to vegetables on first year gardens, *including* three-foot paths between each nine-foot garden, is:

$18 \times 14 \times 12 = 3024$ square feet

Add 5-foot strip for path $-168 \times 5 = 840$

Total ..... 3864 square feet

Number of square feet in acre $= 43560$;

$3864/43560 = 1/11.27$ acres.

At this rate the vegetable gardens produced for the pupils $11.27 \times \$42.25 = \$476.15$ per acre.

The flower gardens are not reckoned in because there is no way of getting at their value. As a rule the flowers are better than the vegetables.

I believe the pupils followed instructions to underestimate rather than over estimate, with not more than one exception. Dividing the above figures by two we still have a fair profit per acre aside from the value of instruction.

Of the 3864 square feet on which produce is reckoned 756 square feet plus 840 square feet = 1596 square feet, or nearly one-half is path.

Nine of the above first-year pupils have asked for the privilege of caring for their gardens during the summer.

BOTANY GARDENS.

June, 1911.

	heads Lettuce	heads Endive	hills Artichoke	bunches Salsify	
Edna Pitts	25	9	3	6	$1.25
Ruth Crinklaw	24	9			.85

	Mustard	Kale	Cabbage	Cauliflower	
Elsie Meyers	25c	2	1	9 + radishes	1.50
	Radishes	Turnips	Rutabaga	Kohl-rabi	
	18	9	6	9	1.20

SQUASHES.

	Summer Crookneck	Scallop	Hubbard	
Seisuke	15	15	2	.75

	Coriander	Dill	Parsnip	Celery	Carrot	Parsley	
Aaron Ely	50c	6	9	6	9	50	2.25
							$7.80

CONDITION OF BOTANY GARDENS.

Family	Varieties Good	Varieties Poor
Cucurbitaceae—squash	18	....
Labiatae—mint	2	9
Caryophyllaceae—pink	14	....
Leguminosae—legume	6	6
Solanaceae—nightshade	8	3
Solanaceae—nightshade	8	3
Papaveraceae—poppy	7	4
Cruciferae—mustard	12	2
Compositae—sunflower	13	....
Compositae—sunflower	12	1
Umbelliferae—parsley	8	3
Papaveraceae—poppy	9	2
Total	117	33

GENERAL FARM EXPERIMENTS.

It is the idea of the agricultural department of the Oxnard High School that experiments should be performed for the benefit of the community—that here should be tried out ideas new and old on the ground that if the ideas are poor ones it is better for *one* to make a failure than *many*, and if they are good ideas progress in the community along new lines may not be delayed by the natural conservativeness of a farming community.

Oxnard is the center of one of the richest agricultural regions in California. In Oxnard is located the largest beet sugar factory in the world, and the county controls the lima bean industry of the world. Obviously the first duty of the agricultural department in its general experiments is along the line of beets and beans.

Briefly stated the experiments as outlined are as follows:

Sugar Beets—
- Experiments with beet seed.
- Fertilization.
- Rotation.
- Time of planting.

Lima Beans—
- Early planting to avoid rains.
- Rotation.
- Special studies.

Grain—
Control of smut.

Alfalfa—
- Arabian, Turkestan, Common } Inoculated and not inoculated.

Fertilizer Test Plots.

Horticulture—
- Hybridizing and selection.
- Budding and grafting.
- Raising of mushrooms.
- New introductions.
- Testing of varieties and kinds of fruits, trees and small fruits best suited to the locality.

Forestry—
- Eucalyptus.
- Shade and ornamental trees.

Miscellaneous—
- Alkali resistent plants.

Collections—
- Fungous pests.
- Insect pests.
- Weed pests.
- Economic plants.

[One of the most interesting and profitable topics for observational study by secondary school students is that of variation in plants and animals, especially when it is made a basis for practical work in scoring, judging, or breeding. In this connection the book by Dean E. Davenport on "Domesticated Animals and Plants," and recently published by Ginn and Company, is of sufficient importance to deserve special notice. It should be found in every high school library and a sufficient number of copies should be provided to insure its perusal by each student. Teachers should read the author's preface thoughtfully. E. B. B.]

APPENDIX A.

LISTS OF EQUIPMENT FOR AGRICULTURAL SCIENCES AND SPECIAL SUBJECTS.

OXNARD UNION HIGH SCHOOL.

Equipment for General Science and Agricultural Botany.

A. Farm Tools.

14 budding knives.
1 cultivator with attachments.
2 forks—hay.
1 fork—manure.
6 forks—spading.
3 files—flat.
1 farm level—Bostrom's.
1 hatchet.
15 hoes.
15 rakes—garden.
3 shovels—round pointed.
2 spools garden twine.
1 spray—pumping-lightning insect.
1 target for farm level.
14 trowels—garden.
3 weeds—finder.

B. Glassware.

10 bottles—8 oz.
12 beakers—4 oz.
24 bottles—4 oz.
18 bottles—2 oz.
4 bottles—tincture.
1 clay pipe.
18 capillaries 2 mm.
18 capillaries 1 mm.
6 chimneys—student lamp.
5 flasks—boiling.
8 funnels—small.
9 jars—glass fruit—1 qt.
2 jars—glass fruit—1 qt.
4 doz. plates—glass, plain—2½ x 2½.
18 tumblers—glass.
2 doz. test tubes.
6 doz. vials—homeopathic.
10 window panes, 7 x 9.
1 graduate 250 cc.
4 graduates 100 cc.
10 test tube holders.
4 bottles for milk tester.
1 funnel for milk tester.
1 pipette for milk tester.

C. Enameled Ware.

2 double boilers.
2 custard cups.
4 lids—tin.
7 milk pans, 6-8 qts., deep.
2 milk pans, 8-6 qts., shallow.
1 1-qt. measure.
7 piepans, shallow.
7 piepans.
13 saucepans, shallow.
2 stewpans, deep.

D. Bacteriology Supplies.

2-lb. agar—agar.
½ lb. corrosive sublimate.
1 lb. cotton—absorbent.
2 oz. extract beef.
1 bottle Farmogerm.
1 box Lactone.
10 microscope needles.
24 petri dishes.
¼ lb. salicylic acid.
1 sterilizer, steam (wash boiler).

E. Botanical Materials.

1 compound microscope.
1-oz. cover glasses—1 oz.
12 dissecting microscopes, complete.
11 instrument sets.
2½ doz. microscope slides.
9 medicine droppers.
1 plant press.
1 razor strop.
2½ doz. slides, microscope.
6 Sterns droppers.
10 watch glasses.
2 oz. Canada Balsam.
3 oz. Eosine.
2 oz. Xylol.
1 bottle Barley Rust.

F. Chemicals.

1 oz. ammonium oxalate crystals.
3 qts. aqua ammonia concentrated.
2 oz. ammonia oxalate sat. solution alphanapthol.
3 lbs. copper sulphate.
5 lbs. copper carbonate.
4 lbs. cane sugar.
½ oz. copper chloride.
8 oz. caustic potash, 10%.
1 oz. grape sugar.
3 qts. hydrochloric acid.
4 oz. iodine solution.
3 qts. lime water.
1 pt. nitric acid.
1 oz. potassium ferro cyanide—crystals.
2 oz. peroxide of hydrogen.
1 oz. potassium ferro cyanide solution.
½ doz. litmus sheets.
4 crucibles.
1 pkg. filter paper.
½ oz. phosphoric acid.
6 oz. phosphoric acid, ½%.
½ lb. Rochelle Salts.
½ lb. rock salt.
½ lb. sodium sulphate.
½ pkg. shaker salt.
½ lb. sodium carbonate.
¼ lb. soda—saleratus.
3 lbs. sulphur flowers.
1 oz. starch.
3 qts. sulphuric acid.

G. Miscellaneous.

1 ballance—spring—30 lbs.
3 balances—spring—2000 g.
6 Bunsen burners.
4 brushes—test tube.
1 bicycle pump.
1 tube bicycle cement.
2 blocks weights.
3 balances—Harvard.
1 Babcock milk tester.
2 doz. corks—rubber.
3 doz. corks—small.
1 doz. clothes pins.
1 lb. grafting wax.
1 hammer.
2 balls knitting cotton No. 18.
1 map relief—United States.
1 map relief—California.
1 flower chart.
30 minerals.
2 meter sticks.
1 tape measure, 100 ft., linen.
1 tape measure, 50 ft., linen.
1 tape measure, steel, 50 ft.
2 doz. tags—1-in. square.
6 lbs. vaseline (cheap).
4 balls waxed string.
1 spl. wire—copper.
1 set Washington school collection minerals.
1 cake whale oil soap.
1 pt. formaldehyde.
2 oz. gum arabic.
4 lbs. Paris green.
1 lb. tobacco dust.
2 oil cans.
500 pot labels, 4-in., painted.
3 rolls Passe Partout.
1 lb. raffia.

4 ring stands, complete.
10 ft. rubber tubing.
1 sponge.
1 globe.
9 spoons—tea.
4 spoons—large.
4 sticks sealing wax.
1 stencil outfit complete.
7 sieves—varying mesh.
1 thermometer—centigrade.
4 spls. thread.
¼ lb. tallow.
1 pkg. tacks, No. 9.
4 pkgs. tacks, No. 10.
4 three-cornered files.
2 doz. thimbles.
1 vegetable chart.
1 whisk broom.
½ yd. wire gauze.
¼ lb. zinc chips.
4 lbs. beeswax.
2 pts. cider (sweet).
2 pts. grape juice.
1 qt. linseed oil.
½ lb. rosin.
1 pt. vinegar.
2 qts. wood alcohol.

LIST OF DAIRY APPARATUS AND SUPPLIES.

Furnished by E. P. Terry, Teacher in the Ferndale Union High School, Ferndale, Humboldt County, California.

The work is carried on in one part of the Chemical Laboratory.

36 milk test bottles, 10%.
24 cream test bottles, 30%.
12 skim milk test bottles.
18 17.6 cc. milk pipettes.
6 9 cc. milk pipettes.
2 8-oz. graduates.
12 pint milk bottles, lightening tops.
3 floating dairy thermometers, 8-in.
Facilities for obtaining hot water.
1 12-bottle "De Laval" Babcock milk tester.
1 8-bottle "Facile" Babcock milk tester.
1 separator.
2 Marshall acid test outfits (29 cc. pipette; 1 gallon 1/10 normal alkaline solution and indicator or Phenolphthaleine.)
5 300 cc. aluminum beakers for Patrick's moisture test.
1 Gray's moisture test (more accurate than Patrick's.)
6 brushes for test bottles.
1 1-gallon milk can.
1 milk thief.
5 lbs. dairyman's cleaner (washing powder).
4 gallons sulphuric acid for testing.
5 copper cups for pouring water into milk bottles.
1 package of preservative (bichromate of potash or corrosive sublimate).
3 17.5 cc. acid cylinders.
10 caliphers (dividers).
5 Trowbridge calibrators.
1 lb. of mercury.
3 Quevenne lactometers.
3 board of health lactometers.

The above apparatus is sufficient for 10 pupils. Scales used by chemistry class are also suitable cream scales. With the addition of a churn the list is complete enough for a high school course. The total cost of apparatus exclusively of stove for heating water and scales is $150.

For a few demonstrations in dairy bacteriology the following apparatus is used:

12 petri dishes, 50 mm.
6 Erlenmeyer flasks, 500 cc.
12 volumetric pipettes, 1 cc.
2 volumetric pipettes, 100 cc.
1 doz. culture media tubes.
Total cost. $5.00.

For demonstrating the tuberculin test we follow bulletin 199, California Station. Outfit, including ten doses of tuberculin, costs $5.50.

LIST OF DAIRY SUPPLIES FOR HIGH SCHOOL COURSE.

Furnished by W. G. Hummel, Head Department of Agriculture, Fresno High School.

(These supplies are ample for a class of ten. The list includes all supplies ordered this year for the dairy work at the Fresno High School. Some items were ordered in larger sizes or quantities than were necessary for the work this year, but when this is the case it was because for some reason the desired size or quantity could not be secured. The supplies named were made to suffice, this year, for a class of twenty-four students, divided into two sections).

1	100-gallon round bottom wash sink	$ 25.00
1	No. 0 dairy barrel churn	8.00
4	16-quart heavy dairy pails	5.00
3	5-gallon climax milk cans	5.90
1	up-to-date butter printer, for one-pound prints	4.50
3	butter ladles	.75
½	dozen small ideal bottle brushes	1.75
3	dozen 6½-inch 50% cream test bottles	22.50
3	dozen 6½-inch 10% milk test bottles	
1	dozen skim milk test bottles	
1	dozen 17.5 acid measures	1.50
1	dozen 17.6 pipettes	2.00
5	gallons testing acid, in demijohn	6.75
1	combined test water heater and combined filler without lamp	1.85
2	dozen pint t. t. sample jars	1.90
1	dozen 1-quart c. s. milk bottles	1.00
½	dozen half-pint t. t. sample jars	.45
2	dozen numbered bottle tags	1.20
1	Ideal milk sampler	.25
1	automatic acid meter, complete	5.00
1	Farrington alkaline testing outfit, with 100 tablets	1.00
1	dozen 0 to 100 cc. graduated cylinders	9.00
2	churn thermometers	1.00
1	official thermometer	.50
1	set of Eureka adjustable stencils, 1-inch letters, etc.	1.15
1	galvanized butter salting scale	10.00
1	12-bottle Troemner test bottle scale	12.00
1	milk scale (automatic, 30-pound)	5.00
1	Starrett speed indicator	1.00

1	No. 2 lever butter worker	7.50
500	9 x 12 parchment wrappers, plain	.45
1	Ames moisture test	6.00
1	salt test	5.00
2	Quevenne lactometers	4.00
1	12-oz. graduate	.60
1	4-oz. graduate	.35
500	corrosive sublimate tablets	1.75
1	dozen receiving sheets	.75
1	ten-gallon can strainer	1.25
1	14-inch iron mop	.75
3	butter bowls	9.00
1	Babcock tester (6-bottle), about	10.00
		$184.35
	Less ten per cent discount	18.43
		$165.92
1	refrigerator	42.50
1	40-gallon electric weld boiler and heater combined, installed	55.00
	Total	$263.42

In addition to the aboye three cream separators were donated for our use. The white duck coats and aprons were purchased by individual members of the class. [A 12-bottle Babcock tester would be more satisfactory for a class of this size. E. B. B.]

SYNOPSIS OF BILL No. 568, A., LAWS OF 1911, STATE OF WISCONSIN.*

Section 1. Any board having charge of a free high school or a high school having a course of study equivalent (thereto) . . . may establish and maintain . . . a department of manual training, or domestic economy, or *agriculture,* or any or all of said departments. . . . Any school whose course of study or outline of work in manual training, domestic economy, or *agriculture,* has been approved by the state superintendent, and whose teacher has been qualified may, upon application, be placed upon an approved list of schools . . . (and be entitled to state aid equal to . . . one-half the amount actually expended for instruction, . . . not, however, to exceed three hundred and fifty dollars for each department established under this act which shall have been maintained in connection with the high school and the three upper grades next below the high school, but not to exceed two hundred and fifty dollars for each department established under this act, which shall have been connected with only the high school.

* From Bull. 441, University of Wisconsin, by K. L. Hatch.

APPENDIX B.

RECOMMENDED LIST OF BOOKS FOR THE HIGH SCHOOL AGRICULTURAL LIBRARY.

Abrams, Le Roy.	Flora of Los Angeles and Vicinity.
Atkinson.	Fundamentals of Botany.
Bailey, L. H.	Cyclopedia of American Agriculture, 4v.
	Botany.
	Evolution of Our Native Fruits.
	Horticulturist's Rule Book.
	Manual of Gardening.
	Nursery Book.
	Plant Breeding.
	Principles of Agriculture.
	Principles of Fruit Growing.
	Principles of Vegetable Gardening.
	Pruning Book.
Barto. D. O.	Manual of Agriculture; Soils and Crops.
	Secondary School Agriculture.
Bashore.	Sanitation of the Country Home.
Bergen, J. Y.	The Foundations of Botany.
Bricker, G.	Teaching of Agriculture in the High School.
Brewer.	Rural Hygiene.
Brooks.	Manures, Fertilizers, and Farm Crops.
	Soils and How to Treat Them.
Brigham, A. A.	Progressive Poultry Culture.
Brown, E.	Races of Domestic Poultry.
Card, F. W.	Bush Fruits.
	Farm Management.
Coburn, F. D.	Alfalfa.
	Swine in America.
Comstock, J. H. and A. B.	Manual for the Study of Insects.
	Insect Life.
Conn, H. W.	Agricultural Bacteriology. *Second Edition.*
	Bacteria, Yeasts, and Moulds in the Home.
	Practical Dairy Bacteriology.
Craig, J. A.	Judging Live Stock.
Dadant.	Landsstroth on the Honey Bee.
Darwin, C. R.	Variation of Plants and Animals Under Domestication.
Davenport, E.	Education for Efficiency.
	Domesticated Plants and Animals.
	Principles of Breeding.

Davidson and Chase.	Farm Machinery.
Day, G. E.	Swine.
Duggar, B. M.	Fungous Diseases of Plants.
Edgar.	Story of a Grain of Wheat.
Elliot.	Farm Drainage.
Fairchild.	Rural Wealth and Welfare.
Farrington and Woll.	Testing Milk and Its Products.
Fiske, George B.	Poultry Appliances and Handicraft.
	Poultry Architecture.
French.	Book of Vegetables.
Gifford, John.	Practical Forestry.
Goodrich, C. L.	First Book of Farming.
Gray, Asa.	Field, Forest and Garden Botany.
Halligan, J. E.	Fundamentals of Agriculture.
Halstead, B. D.	Barn Plans and Outbuildings.
Hemenway.	How to Make School Gardens.
Henry, W. A.	Feeds and Feeding.
Hilgard.	Soils.
Hilgard and Osterhout.	Agriculture for Schools of the Pacific Slope.
Hodge, C. F.	Nature Study and Life.
Hopkins, C. G.	Soil Fertility and Permanent Agriculture.
Hume, H. H.	Citrus Fruits and Their Culture.
Hunt, T. F.	Cereals in America.
	Forage and Fibre Crops in America.
Hunter, G. W.	Essentials of Biology.
Jackson and Daugherty.	Agriculture through the laboratory and school garden.
Jepson, W. L.	Flora of Western Middle California. *Second Edition.*
Jordan, W. H.	Feeding of Animals.
Kellaway, H. J.	How to Lay Out Suburban Home Grounds.
King, F. F.	Physics of Agriculture.
	The Soil.
	Irrigation and Drainage.
Lassar-Cohn.	Chemistry of Common Life.
Lipman, J. G.	Bacteria in Relation to Country Life.
Lodeman, E. G.	Spraying Plants.
Lyon and Fippin.	Soils.
McLaren, John.	Gardening in California.
Maynard, S. T.	Successful Fruit Culture.
Mayo.	Care of Farm Animals.
	Diseases of Animals.
Michels, J.	Dairy Farming.
Morrow.	Soils and Crops of the Farm.
Osterhout, W. J. V.	Experiments With Plants.
Paddock and Whipple.	Fruit Growing in the Arid Regions.
Percival.	Agricultural Botany.
Plumb, C. S.	Types and Breeds of Farm Animals.
Roberts, I. P.	Fertility of the Land.
	The Horse.
	The Farmer's Business Handbook.

Robison, C. H.	Agricultural Instruction in the Public High Schools of the United States. (Columbia University Press, N.Y.)
Roth, F. R.	First Book of Forestry.
Russel and Hastings.	Experimental Dairy Bacteriology.
Sanderson, E. D.	Insects Injurious to Staple Crops.
Sargent, F. L.	Corn Plants.
Smith, H. R.	Profitable Stock Feeding.
Smythe, W. E.	The Conquest of Arid America.
Snyder, H. S.	Chemistry of Plant and Animal Life.
	Soils and Fertilizers.
Stevenson and Schaub.	Soil Physics Laboratory Guide.
Spillman.	Farm Grasses.
Strassberger, E., and Hillhouse, W.	Handbook of Practical Botany.
Taft, L. R.	Greenhouse Management.
Taylor.	Agricultural Economics.
Valentine, C. S.	How to Keep Hens for Profit.
Van Norman, H. E.	First Lessons in Dairying.
Van Slyke.	Testing Milk.
Voorhees, E. B.	Fertilizers.
Warren, G. F.	Elements of Agriculture.
	Laboratory Exercises in Farm Management.
Warington.	Physical Properties of the Soil.
Watson, G. C.	Farm Poultry.
Waugh, F. A.	Fruit Harvesting, Storing and Marketing.
	Landscape Gardening.
	Plums and Plum Culture.
	Systematic Pomology.
Weed, C. M.	Farm Friends and Farm Foes.
Weed and Emerson.	School Garden Book.
Wheelock, I. G.	Birds of California.
Whitman, H. J.	The Feeding of Animals.
Wickson, E. J.	California Fruits and How to Grow Them.
	California Vegetables.
Wilkinson, J. W.	Practical Agriculture.
Wing, H. H.	Milk and Its Products.
Wing, J. E.	Sheep Farming in America.
Wing, J. E.	Farm Buildings.
	Year Book United States Department of Agriculture, 1906 to the Present.

STATION PUBLICATIONS AVAILABLE FOR DISTRIBUTION.

REPORTS.

1896. Report of the Viticultural Work during the seasons 1887-93, with data regarding the Vintages of 1894-95.

1897. Resistant Vines, their Selection, Adaptation, and Grafting. Appendix to Viticultural Report for 1896.

1902. Report of the Agricultural Experiment Station for 1898-1901.

1903. Report of the Agricultural Experiment Station for 1901-03.

1904. Twenty-second Report of the Agricultural Experiment Station for 1903-04.

BULLETINS.

Reprint. Endurance of Drought in Soils of the Arid Region.

No. 128. Nature, Value, and Utilization of Alkali Lands, and Tolerance of Alkali. (Revised and Reprint, 1905.)

133. Tolerance of Alkali by Various Cultures.

147. Culture Work of the Sub-stations.

149. California Sugar Industry.

151. Arsenical Insecticides.

153. Spraying with Distillates.

159. Contribution to the Study of Fermentation.

162. Commercial Fertilizers. (Dec. 1, 1904.)

165. Asparagus and Asparagus Rust in California.

167. Manufacture of Dry Wines in Hot Countries.

168. Observations on Some Vine Diseases in Sonoma County.

169. Tolerance of the Sugar Beet for Alkali.

170. Studies in Grasshopper Control.

171. Commercial Fertilizers. (June 30, 1905.)

172. Further Experience in Asparagus Rust Control.

174. A New Wine-cooling Machine.

176. Sugar Beets in the San Joaquin Valley.

177. A New Method of Making Dry Red Wine.

178. Mosquito Control.

179. Commercial Fertilizers. (June, 1906.)

180. Resistant Vineyards.

181. The Selection of Seed-Wheat.

182. Analysis of Paris Green and Lead Arsenic. Proposed Insecticide Law.

183. The California Tussock-moth.

184. Report of the Plant Pathologist to July 1, 1906.

185. Report of Progress in Cereal Investigations.

No. 186. The Oidium of the Vine.

187. Commercial Fertilizers. (January, 1907.)

188. Lining of Ditches and Reservoirs to Prevent Seepage and Losses.

189. Commercial Fertilizers. (June, 1907.)

190. The Brown Rot of the Lemon.

191. California Peach Blight.

192. Insects Injurious to the Vine in California.

193. The Best Wine Grapes for California; Pruning Young Vines; Pruning the Sultanina.

194. Commercial Fertilizers. (Dec., 1907.)

195. The California Grape Root-worm.

197. Grape Culture in California; Improved Methods of Wine-making; Yeast from California Grapes.

198. The Grape Leaf-Hopper.

199. Bovine Tuberculosis.

200. Gum Diseases of Citrus Trees in California.

201. Commercial Fertilizers. (June, 1908.)

202. Commercial Fertilizers. (December, 1908.)

203. Report of the Plant Pathologist to July 1, 1909.

204. The Dairy Cow's Record and the Stable.

205. Commercial Fertilizers. (December, 1909.)

206. Commerical Fertilizers. (June, 1910.)

207. The Control of the Argentine Ant.

208. The Late Blight of Celery.

209. The Cream Supply.

210. Imperial Valley Settlers' Crop Manual.

211. How to Increase the Yield of Wheat in California.

212. California White Wheats.

213. The Principles of Wine-making.

CIRCULARS.

No. 1. Texas Fever.
5. Contagious Abortion in Cows.
7. Remedies for Insects.
9. Asparagus Rust.
11. Fumigation Practice.
12. Silk Culture.
15. Recent Problems in Agriculture. What a University Farm is For.
19. Disinfection of Stables.
29. Preliminary Announcement Concerning Instruction in Practical Agriculture upon the University Farm, Davisville, Cal.
30. White Fly in California.
32. White Fly Eradication.
33. Packing Prunes in Cans. Cane Sugar vs. Beet Sugar.
36. Analyses of Fertilizers for Consumers.
39. Instruction in Practical Agriculture at the University Farm.
46. Suggestions for Garden Work in California Schools.
47. Agriculture in the High Schools.
No. 48. Butter Scoring Contest, 1909.
50. Fumigating Scheduling.
51. University Farm School.
53. Announcement of Farmers' Short Courses for 1910.
54. Some Creamery Problems and Tests.
55. Farmers' Institutes and University Extension in Agriculture.
58. Experiments with Plants and Soils in Laboratory, Garden, and Field.
59. Tree Growing in the Public Schools.
60. Butter Scoring Contest, 1910.
61. University Farm School.
62. The School Garden in the Course of Study.
63. How to Make an Observation Bee Hive.
64. Announcement of Farmers' Short Courses for 1911.
65. The California Insecticide Law.
66. Insecticides and Insect Control.